REMARKS

Claims 20, 23, 29, 31, 32, 38, 43, 44, and 50 have been amended. Claims 67 - 88 have been added to claim the invention with more particularity. No claims have been canceled. Accordingly, Claims 17 - 88 are now pending.

Claim 50 has been objected to as depending from canceled Claim 1. Claim 50 has been corrected so as to depend from pending structure Claim 47. Accordingly, the objection to Claim 50 should be withdrawn.

The dependencies of Claim 29 and 31 have also been corrected.

Claims 17 - 66 have been rejected under 35 USC 102(e) as anticipated by Litwin et al. ("Litwin"), U.S. Patent 6,100,770. This rejection is respectfully traversed in view of the revisions to the claims.

Litwin discloses a varactor formed with an insulated-gate field-effect transistor whose source region 13, 23, or 33 and drain region 14, 24, or 34 are situated in a well 12, 22, or 32. Source 13, 23, or 33 and drain 14, 24, or 34 are shorted together by way of common electrode C_A connected to both source electrode 17, 27, or 37 and drain electrode 18, 28, or 38. Electrode C_B is connected to gate electrode 19, 29, or 39 that contacts polysilicon gate electrode 16, 26, or 36.

A first operational mode for Litwin's varactor is described at col. 5, lines 21 - 58, with respect to the schematic varactor diagram of Fig. 4 corresponding to the varactor of Fig. 1. A voltage is applied between electrodes C_A and C_B to produce a depletion layer, represented by depletion boundary 41, below the gate dielectric layer that underlies polysilicon gate electrode 16 in the varactor of Figs. 4 and 1. Litwin states that the capacitance between electrodes C_A and C_B is the series combination of the gate dielectric capacitance and the depletion layer capacitance. Adjusting the voltage between electrodes C_A and C_B causes the depletion layer capacitance to change so as to change the overall capacitance between electrodes C_A and C_B.

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Litwin describes two additional varactor operational modes at col. 5, lines 59 - 67. In the first of the additional operational modes, the depletion layer capacitance is controlled by applying a suitable voltage to the well (item 12 in Figs. 1 and 4) while electrodes C_A and C_B

are maintained at respective fixed potentials. The second of the additional operational modes entails providing a fixed potential to one of electrodes C_A and C_B, connecting the other of electrodes C_A and C_B to the well (again item 12 in Fig. 4), and controlling the capacitance between electrodes C_A and C_B by way of a suitable voltage applied to the well electrode.

Independent Claim 17 recites that the gate-to-body voltage is maintained <u>approximately constant</u> as the plate-to-body voltage is varied.

Insofar as Applicant's attorney understands how the Examiner is attempting to analogize elements of Litwin's varactor(s) to the subject matter of Claim 17, the gate-to-body voltage in Litwin is the voltage between gate electrode 19, 29, or 39 and well 12, 22, or 32. <u>Nowhere</u> does Litwin indicate that the voltage between gate electrode 19, 29, or 39 and well 12, 22, or 32 is maintained approximately constant in any of Litwin's varactor operational modes. Hence, Litwin does not anticipate Claim 17.

Furthermore, <u>nothing</u> in Litwin suggests that it would be advantageous for the voltage between gate electrode 19, 29, or 39 and well 12, 22, or 32 to be maintained approximately constant. Accordingly, Claim 17 is patentable over Litwin.

Claims 18 - 22 and 47 - 54 all depend (directly or indirectly) from Claim 17. New Claim 69 also depends on Claim 17. Consequently, dependent Claims 18 - 22, 47 - 54, and 69 are patentable over Litwin on the same basis as Claim 17.

In addition, Litwin fails to disclose further limitation of each of dependent Claims 18, 20, 53, and 69. Separate grounds are therefore present for allowing Claims 18, 20, 53, and 69 over Litwin.

More particularly, dependent Claim 18 specifies that the claimed structure includes componentry for maintaining the gate-to-body voltage approximately constant. Since Litwin does not disclose that the voltage between gate electrode 19, 29, or 39 and well 12, 22, or 32 is maintained approximately constant, Litwin does not disclose the further limitation of Claim 18 that the varactor-containing structure include componentry for maintaining the gate-to-body voltage approximately constant.

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Dependent Claim 53 specifies that the body region includes a body contact portion more heavily doped than the surface depletion region. Litwin does not disclose that well 12, 22, or 32 includes a contact portion more heavily doped than the surface depletion layer defined by depletion boundary 41. Accordingly, Litwin does not disclose the further limitation of Claim 53.

Each of dependent Claims 20 and 69 recites that an inversion layer which meets the plate region selectively appears and disappears in the body region below the gate electrode.

Litwin does not mention that any of its varactors are operated so as to produce an inversion layer, or conducting channel, in well 12, 22, or 32 below polysilicon gate electrode 16, 26, or 36. Fig. 4 of Litwin illustrates a depletion layer but no inversion layer, or conducting channel, in well 12. The disclosure that Litwin presents at col. 5, lines 21 - 58, for the first operational mode is phased in language strongly suggesting the absence of an inversion layer, or conducting channel, in the well below the gate electrode.

In short, as far as Applicant's attorney can determine, none of Litwin's varactors is operated in a mode that entails forming an inversion layer, or conducting channel, in the well below the gate electrode. Litwin therefore fails to meet the further limitation of each of Claims 20 and 69 that an inversion layer which meets the plate region selectively appears and disappears in the body region below the gate electrode. Litwin also fails to meet the limitation of Claim 20 that the varactor have a capacitance dependent on the inversion area in combination with the plate area.

Independent Claim 23 has been amended to recite that an inversion layer which meets the plate region selectively appears and disappears in the body region below the gate electrode. Independent Claim 38, which previously introduced an inversion layer that meets the plate region, has been amended to recite that the inversion layer selectively appears and disappears in the body region below the gate electrode. For the reasons given in the two preceding paragraphs, Litwin does not meet the inversion-layer limitation of Claim 23 or 38. Hence, Litwin does not anticipate Claim 23 or 38.

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As far Applicant's attorney can determine, nothing in Litwin would provide a person skilled in the art with any incentive or motivation for operating any of Litwin's varactors in a

mode that results in an inversion layer being formed in well 12, 22, or 23 below polysilicon gate electrode gate 16, 26, or 36.

Furthermore, even if there were some reason for Litwin to use such an inversion layer, a key feature of the present invention as recited in Claims 23 and 38 is that the inversion layer selectively appears and disappears. The appearance and disappearance of the inversion layer in the present invention enables large changes to be made in the varactor capacitance. Nothing in Litwin would provide a person skilled in the art with any reason for operating Litwin's varactor in a mode where such an inversion layer selectively appears and disappears. Accordingly, Claims 23 and 38 are patentable over Litwin.

Litwin also fails to meet the limitations of Claim 38 (a) that the varactor have a maximum capacitance dependent on the inversion layer in combination with the plate area and (b) that the plate and inversion areas be controlled to control the minimum and maximum capacitances of the varactor. This is an additional reason why Claim 38 is patentable over Litwin.

Claims 24 - 31 and 55 - 62 all depend (directly or indirectly) from Claim 23. Claims 39 - 46 all depend directly (directly or indirectly) from Claim 38. Consequently, dependent Claims 23 - 31, 39 - 46, and 55 - 62 are variously patentable over Litwin for the same reasons as Claims 23 and 38.

Litwin does not disclose the further limitation of any of dependent Claims 29, 39, 40, 43, and 61. Separate grounds are thereby provided for allowing Claims 29, 39, 40, 43, and 61 over Litwin.

Independent Claim 32 has been amended to recite that at least two of the finger portions of the plate region extend longitudinally non-parallel to one another.

In Fig. 10 of Litwin, fingers 83, 84, and 91 of comb-shaped region 90 all extend longitudinally parallel to one another. Litwin does not meet the further limitation of Claim 32 that at least two of the finger portions of the plate region extend longitudinally non-parallel to one another. Litwin therefore does not anticipate Claim 32.

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Additionally, nothing in Litwin would provide a person skilled in the art with any reason for modifying Litwin's comb-shaped region 90 to have at least two finger portions that extend longitudinally non-parallel to one another. There would be no incentive for so modifying Litwin. Accordingly, Claim 32 is patentable over Litwin.

Claims 33 - 37 all depend (directly or indirectly) from Claim 32. New Claim 70 depends from Claim 32. As a result, Claims 33 - 37 and 70 are patentable over Litwin for the reasons as Claim 32.

Litwin does not disclose the further limitation of either of dependent Claims 36 and 70. These two dependent claims are thus separately allowable over Litwin.

Independent Claim 63 recites that the body region includes a body contact portion more heavily doped than the surface depletion region. As discussed above in connection with dependent Claim 53, Litwin does not disclose this body-contact-portion limitation. Litwin therefore does not anticipate Claim 53.

Nothing in Litwin would furnish a person skilled in the art with any suggestion for providing well 12, 22, or 32, with a well contact portion more heavily doped than the well's depletion layer. As a result, Claim 53 is patentable over Litwin.

Claims 64 - 66 all depend from Claim 53. New Claims 67 and 68 both depend (directly or indirectly) from Claim 63. Hence, Claims 64 - 68 are patentable over Litwin for the same reasons as Claim 63.

Litwin does not disclose the further limitation of Claim 67. Consequently, Claim 67 is separately allowable over Litwin.

New independent Claim 71 is a method counterpart of independent Claim 17 subject to the further limitation that the plate-to-body voltage be varied, while maintaining the gate-to-body voltage approximately constant, so as to cause an inversion layer that meets the plate region to selectively appear and disappear in the body region below the gate electrode. Claim 71 is patentable over Litwin for the same reasons as Claim 17. In addition, Litwin does not meet the inversion-layer limitation of Claim 71 for the same reasons as presented above in

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connection with Claims 23 and 38. This establishes a separate basis for allowing Claim 71 over Litwin.

New Claims 72 - 78 all depend (directly or indirectly) from Claim 71. Claims 72 - 78 are thus patentable over Litwin on the same basis as Claim 71. Litwin also fails to disclose the further limitation of each of Claims 72 and 73, thereby providing separate bases for allowing Claims 72 and 73 over Litwin.

New independent Claim 79 is a method counterpart of independent Claim 23. As a result, Claim 79 is patentable over Litwin for the same reasons as Claim 23.

New Claims 80 - 88 all depend (directly or indirectly) from Claim 79 and are thus patentable over Litwin on the same basis as Claim 79. In addition, Litwin fails to disclose the further limitation of dependent Claim 83. This establishes a separate basis for allowing Claim 83 over Litwin.

In summary, Claims 17 - 88 have been shown to be patentable over Litwin. Claim 50 has been amended to overcome the objection relating to the claim dependency. Accordingly, Claims 17 - 88 should be allowed so that the application may proceed to issue.

Please telephone applicant's attorney at 408-453-9200, ext. 1371, if there are any questions.

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APPENDIX

CLAIMS 20, 23, 29, 31, 32, 38, 43, 44, AND 50, WITH ANNOTATIONS TO INDICATE REVISIONS, OF U.S. PATENT APPLICATION 09/903,059, ATTORNEY DOCKET NO. NS-4971 US

20. (Amended) A structure as in Claim 19 wherein the plate region occupies a lateral plate area along the primary surface, the varactor has a minimum capacitance dependent on the plate area, an inversion layer that meets the plate region <u>selectively appears and disappears</u> [occurs] in the body region <u>below the gate electrode</u> under control of the plate and <u>body</u> [gate] electrodes, the inversion layer occupies a lateral inversion area along the primary surface, and the varactor has a maximum capacitance dependent on the inversion area in combination with the plate area.

23. (Twice amended) A structure comprising a varactor which comprises:

a plate region and body region of a semiconductor body, the body region being of a first conductivity type, the plate region being of a second conductivity type opposite to the first conductivity type, the plate and body regions meeting each other to form a p-n junction;

a plate electrode and a body electrode respectively connected to the plate and body regions, the plate electrode being at a plate-to-body bias voltage relative to the body electrode;

a dielectric layer situated over the semiconductor body and contacting the body region; and

a gate electrode situated over the dielectric layer at least where the dielectric layer contacts material of the body region, the gate electrode being at a gate-to-body bias voltage relative to the body electrode, the gate-to-body voltage differing from the plate-to-body voltage, the gate-to-body voltage varying as a function of the plate-to-body voltage as the plate-to-body voltage is varied <u>during operation of the varactor to cause an inversion layer that meets the plate region to selectively appear and disappear in the body region below the gate electrode</u>.

29. (Amended) A structure as in Claim <u>28</u> [23] wherein the plate region occupies a lateral plate area along the primary surface, the varactor has a minimum capacitance dependent on the plate area, [an inversion layer that meets the plate region occurs in the body region under control of the plate and gate electrodes,] the inversion layer occupies a lateral inversion area along the

primary surface, and the varactor has a maximum capacitance dependent on the inversion area in combination with the plate area.

31. (Amended) A structure as in Claim 30 [29] wherein the plate region comprises a main plate portion and at least one finger portion continuous with the main plate portion, extending laterally away from the main plate portion, and meeting the body region therealong.

32. (Twice amended) A structure comprising:

a plate region and a body region of a semiconductor body, the body region being of a first conductivity type, the plate region being of a second conductivity type opposite to the first conductivity type, the plate and body regions extending to a primary surface of the semiconductor body and meeting each other to form a p-n junction, the plate region comprising a main plate portion and a plurality of finger portions continuous with the main plate portion, extending laterally away from the main plate portion, and meeting the body region therealong, at least two of the finger portions extending longitudinally non-parallel to one another;

a dielectric layer situated over the semiconductor body and contacting the plate region; and

a gate electrode situated over the dielectric layer at least where the dielectric layer contacts material of the body region.

38. (Twice amended) A method comprising:

selecting a varactor which comprises (a) a plate region and a body region of a semiconductor body, (b) a dielectric layer situated over the semiconductor body and contacting the body region, [and] (c) a gate electrode situated over the dielectric layer at least where the dielectric layer contacts material of the body region, and (d) a plate electrode and a body electrode respectively connected to the plate and body regions, the body region being of a first conductivity type, the plate region being of a second conductivity type opposite to the first conductivity type, the plate and body regions meeting each other to form a p-n junction and extending to a primary surface of the semiconductor body, the plate region occupying a lateral plate area along the primary surface, the varactor having a minimum capacitance dependent on the plate area, an inversion layer that meets the plate region selectively appearing and disappearing [occurring] in the body region below the gate electrode as a plate-to-body bias

voltage applied between the plate and body electrodes is varied during operation of the varactor, the inversion layer occupying a lateral inversion area along the primary surface, the varactor having a maximum capacitance dependent on the inversion area in combination with the plate area; and

adjusting the plate and inversion areas to control the minimum and maximum capacitances of the varactor.

43. (Amended) A method as in Claim 38 wherein [the selecting act includes providing the varactor with a plate electrode and a body electrode respectively connected to the plate and body regions, the plate electrode being at a plate-to-body bias voltage relative to the body electrode,] the gate electrode is [being] at a gate-to-body bias voltage relative to the body electrode, the method further including maintaining the gate-to-body voltage approximately constant as the plate-to-body voltage is varied.

44. (Amended) A method as in Claim 38 wherein [the selecting act includes providing the varactor with a plate electrode and a body electrode respectively connected to the plate and body regions, the plate electrode being at a plate-to-body bias voltage relative to the body electrode,] the gate electrode is [being] at gate-to-body bias voltage relative to the body electrode, the method further including causing the gate-to-body voltage to differ from the plate-to-body voltage and to vary as a function of the plate-to-body voltage as the plate-to-body voltage is varied.

50. (Amended) A structure as in Claim 47 [1] wherein the circuitry comprises an inductor.